

**IMPACTS OF BACKCOUNTRY RECREATION ACTIVITIES
ON MOUNTAIN CARIBOU**

by
K. Simpson
and
E. Terry



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In 1992, the Provincial Government initiated a co-operative biodiversity research program with funding from the Corporate Resource Inventory Initiative, the British Columbia Ministries of Forests (Research Branch), Environment, Lands, and Parks (Wildlife and Habitat Protection Branches), and Tourism and Culture (Royal B.C. Museum), and the Forest Resource Development Agreement (FRDA II).

In 1995, the Ministry of Forests Research Branch and the Ministry of Environment, Lands and Parks developed a biodiversity research and extension strategy, with the assistance of the provincial research community. This strategy was presented to Forest Renewal BC (FRBC), who provided funding for a program beginning in 1995. The goal of the extension component of this program is to extend information to scientists, resource managers, and the public through biodiversity publications. These publications are intended to increase awareness and understanding of biodiversity, promote the concepts and importance of conserving biodiversity, and communicate provincial government initiatives related to biodiversity. We hope that they will be used as tools for the conservation of British Columbia's rich, living legacy.

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**IMPACTS OF
BACKCOUNTRY RECREATION ACTIVITIES
ON MOUNTAIN CARIBOU**

Management Concerns,
Interim Management Guidelines
and
Research Needs

by
K. Simpson
and
E. Terry



Ministry of Environment, Lands and Parks
Wildlife Branch
Victoria BC

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March 2000

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ABSTRACT

Mountain caribou are currently red-listed in British Columbia, and have been the focus of forestry-related conflicts for many years. Due to an increase in winter backcountry activities, however, there are growing concerns about the impact of these activities on caribou winter habitat use. This report addresses the potential impacts of four winter backcountry recreation activities on Mountain Caribou, including snowmobiling; heli-skiing; snow-cat skiing and backcountry skiing. Relative to other winter backcountry recreation activities, snowmobiling has the greatest perceived threat to mountain caribou. Management concerns for each Mountain Caribou subpopulation are reviewed, and the probable degree of threat associated with each recreational activity is identified. Interim management guidelines that are either currently in place, or could be considered as options to reduce potential impacts, are outlined. A research approach is suggested to objectively assess risks and answer key questions regarding backcountry recreation impact on caribou.

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INTRODUCTION

Mountain Caribou (*Rangifer tarandus caribou*) are provincially red-listed (candidate for endangered or threatened status) and have been the focus of forestry-related conflicts for many years (Stevenson and Hatler 1985; Simpson et al. 1994, 1997). Due to an increase in winter backcountry activities, however, there are growing concerns about the impact of backcountry activities on Caribou winter habitat use and survival. The increasing interest in recreational snowmobiling, combined with increased road access to high elevation cutblocks and more powerful machines that are able to traverse most Mountain Caribou winter ranges, may represent a threat equal to forestry-related habitat loss for some Mountain Caribou sub-populations (B.C. Ministry of Environment, Lands and Parks, in prep.).

To address this issue, the Ministry of Environment, Lands and Parks requested a review of the potential impacts of backcountry activities on Mountain Caribou. This background information is used to identify key management issues, provide interim management guidelines and outline research needs.

Backcountry winter recreation is an important activity for residents and businesses in many small communities. Although some community groups may support increased regulation of backcountry activities, it is expected that significant public support will be required to implement generally unpopular restrictive management regimes, which may be necessary to maintain some Caribou populations. Means of obtaining that support are also suggested and are incorporated into the recommended research program.

The primary objectives of this report include documentation of the management concerns for each mountain Caribou sub-population and development of interim management guidelines. Research recommendations designed to test various working hypotheses within an adaptive management framework are also presented.

POTENTIAL IMPACTS OF BACKCOUNTRY RECREATION ACTIVITIES ON MOUNTAIN CARIBOU

This section provides a brief overview of the potential impacts of four winter backcountry recreation activities on Caribou including (i) snowmobiling; (ii) heli-skiing; (iii) snow-cat skiing and (iv) backcountry skiing or ski-touring. Snowshoeing would have similar impacts as ski-touring.

Snowmobiling

Although the effects of snowmobiling on various North American ungulate species have been reported (Dorrance et al. 1975; Richens and Lavigne 1978; McLaren and Green 1985; Freddy et al. 1986), overall, the scientific literature available on the impacts of snowmobile activity and human disturbance on Caribou remains somewhat limited. The published research on Caribou has primarily focused on Barren Ground Caribou (*Rangifer tarandus granti*) and Reindeer (*Rangifer tarandus platyrhincus*) that live in open arctic environments (Smith 1988; Tyler 1991). The effects of human disturbance (noise, blasting) on Woodland Caribou (*Rangifer tarandus caribou*) has also been reported (Bradshaw et al. 1997), however, only one study has specifically addressed the impacts of snowmobile activity on the Mountain Caribou ecotype (Simpson 1987).

Overall, these studies suggest the relative impacts of snowmobile activity on ungulates vary with each species, the frequency of snowmobile traffic, noise levels, rate of travel (i.e., snowmobile speed), human scent, visibility and terrain type (open vs. forested).

Relative to other winter backcountry recreation activities, snowmobiling has the greatest perceived threat to Mountain Caribou primarily because high capability snowmobile terrain tends to overlap with high capability Caribou winter range, and snowmobiles can easily access and potentially affect extensive areas of subalpine winter range (Simpson 1987; Webster 1997). Subalpine and alpine ridges not only provide ideal terrain and views for snowmobilers, but also provide preferred late winter range (Jan-Apr) for all Mountain Caribou sub-populations

in British Columbia (Simpson et al. 1997). Therefore, the primary concern is related to habitat displacement from preferred late winter foraging areas, which can result in a decline in physical body condition due to reduced forage intake and increased energy expenditure. Habitat displacement could also result in increased mortality risks by forcing Caribou into steeper terrain that is more susceptible to avalanches. Another concern related to snowmobile activity is the hard-packed trails they provide for predators (e.g., wolves and Cougars). Hard-packed trails allow easy access for predators to reach subalpine foraging areas, which are typically not available to them because of the deeper snow conditions at these elevations compared to lower elevation valley bottom habitats (Bergerud 1996). Although predation (primarily summer) has been shown to limit some Caribou populations (Seip 1992), it is unclear to what extent winter predation contributes to Caribou mortality and population dynamics.

Although the primary concern is related to disturbance of late winter ranges (i.e., alpine/subalpine snowmobiling), Caribou may also be disturbed while on their early winter ranges which include mid- and lower elevation forests (i.e., mid elevation ESSF and ICH habitat types). Snowmobiling in these forested areas may occur as part of commercial trail-based operations (groomed trails) or when high country snowmobilers access alpine areas.

The relative magnitude of potential impacts from snowmobiling is partly related to accessibility. Snowmobile areas that are occupied by Caribou and can be easily accessed from major highways and/or logging/mine roads are most vulnerable to disturbance due to potentially greater use. Therefore, because road access is expected to continue to increase over time (logging/mining), the potential for snowmobiles to reach remote areas will also increase. In addition, there is growing demand for fresh powder snowmobiling, which has resulted in some transportation of snowmobiles by helicopter to alpine areas. This activity could have potential cumulative effects from both helicopter and snowmobile disturbance as well as from the hard-packed trails.

Heli-skiing

Although there are no scientific reports that have specifically addressed the effects of heli-skiing on Caribou, a number of studies have focused on helicopter disturbance of other ungulate species. In general, these studies have shown ungulates response varies according to the level of activity, species, season, quality of cover nearby and the altitude and distance of aircraft from the animal (Foster and Rahe 1983; Bleich et al. 1994; Cote 1996; Frid 1996; Webster 1997). There is clearly the potential for helicopters to disturb Caribou, however, the potential for skiers to significantly affect Caribou winter habitat use is limited by the steep terrain (20–45 degrees) generally preferred by heli-skiers and the spatial area used, which is typically limited to narrow runs. Caribou may also habituate to benign helicopter activity. Although this suggests impacts are likely localized, there is potential for greater impacts (depending on the location and frequency of use), as most heli-ski operations require between 700–3000 km² of territory to operate a feasible business (Beardmore and Kaegi 1999).

Snowcat Skiing

Cat-skiing is similar to heli-skiing except snowcats (caterpillar-tracked vehicles) are used instead of helicopters to transport skiers to the top of the run. Commercial operations target open-bowl areas with deep fresh powder and gladed tree skiing and are growing in popularity in certain areas of the province (e.g., Central Selkirk). Although there are both existing and proposed commercial snowcat operations throughout the province, only about half (7 of 13) of the Caribou sub-populations occur in areas that have high potential for snowcat skiing opportunities (Table 1). The relative impact of snowcat skiing may be somewhat less overall than heli-skiing because (i) it occurs less frequently; (ii) involves less vertical skiing during a given time period (usually 5–10 runs per day); and (iii) it requires relatively less area to operate a commercial cat ski operation (~30–80 km², Beardmore and Kaegi 1999). However, there is potential for cumulative impacts due to snowcat trails that provide easy access for snowmobilers and possibly predators as well. This suggests there may be localized more intense impacts to certain areas. Although snowcat skiing

may occur less frequently than heli-skiing, it may also become more popular because it is relatively less expensive. The extent to which snowcat skiing and Caribou habitat overlap needs further investigation using capability mapping.

Backcountry Skiing

Ski touring or backcountry skiing is an activity that typically involves daily excursions or multi-day trips where participants stay in tents, snow-caves or backcountry cabins. Depending on how accessible the backcountry areas are, ski touring typically requires no motorized equipment. Therefore, the non-motorized nature of backcountry skiing as well as the slow pace at which skiers travel suggest this activity likely has relatively low impacts on Mountain Caribou populations. Although the relative magnitude of impacts from ski touring will vary with the number of skiers and the frequency of use, in general this winter recreation activity poses significantly less threat than motorized activities. Nonetheless, it should be recognized that Caribou could be disturbed by humans on foot due to their keen sense of smell (human scent). Backcountry skiing may also have potentially greater impacts if commercial ski-touring operations (with cabins) access subalpine areas via helicopter. Overall, the information presented above suggests the relative degree of threat among the four winter backcountry recreation activities can be ranked according to their potential impacts on Mountain Caribou habitat and populations (Figure 1). This conceptual framework is simply used to highlight the relative magnitude of potential impacts. In general, potential negative effects are assumed to be greater for motorized compared to non-motorized activities and assumed to increase as the size of the affected habitat area becomes larger (i.e., spatial scale). It should be noted, however, that the relative importance of each activity will vary among geographic areas, sub-population (see next section) and management strategies designed to avoid and or mitigate Caribou-backcountry recreation conflicts.

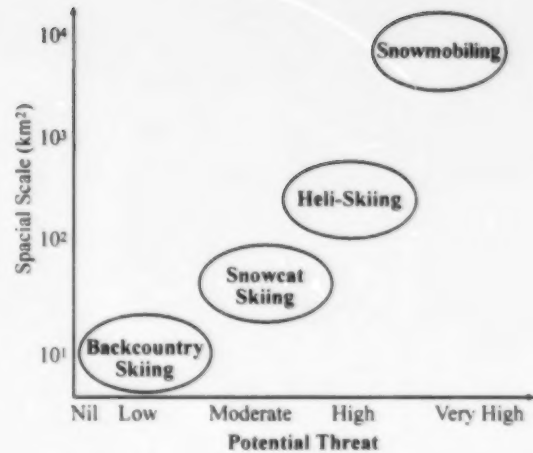


Figure 1. Conceptual framework that ranks the relative degree of threat posed by four winter backcountry recreation activities to Mountain Caribou.

MANAGEMENT CONCERNS FOR EACH CARIBOU SUB-POPULATION

The relative degrees of present threat to Mountain Caribou populations from backcountry activities are not distributed evenly across the province (Table 1). Although snowmobiling is of relatively high concern for most populations (11 of 13), heli-skiing is of greatest concern for the Revelstoke and Central Selkirk populations. Except for the few Caribou that reside in the Robson Valley, the more subdued terrain of the four northernmost Mountain Caribou populations limits their attractiveness to heli-ski operators and greatly reduces the potential for conflicts with those Caribou populations. Similarly, snow-cat skiing poses little if any threat to northern populations whereas to the south, there are significant concerns for the Monashee and Central Selkirk populations. All sub-populations were believed to be at relatively low risk from backcountry ski activities.

South Selkirks

The South Selkirk population represents a small number of Caribou (~50) that reside along the Canada-U.S. border near Salmo and Creston. The snowmobile concerns for these Caribou are concentrated south of Highway 3 particularly in subalpine areas near Bayonne and Blazed Creeks. Overall, the snowmobile concerns are somewhat

Table 1. Backcountry recreation activities and their probable degree of threat to Mountain Caribou sub-populations in British Columbia.

| Subpopulation | Snowmobile | Heli-ski | Snowcat Ski | Backcountry Ski |
|-------------------------|---------------|--------------|-------------|-----------------|
| South Selkirks | Moderate-High | Very Low | Low | Low |
| South Purcells | High | Low | Nil | Low-Moderate |
| Central Selkirks | High | High | Moderate | Low-Moderate |
| Monashees | High | Moderate | Moderate | Low |
| Revelstoke | High | High | Low | Low |
| Central Rockies | Low | Low* | Low | Very Low |
| Wells Gray South | High | Low-Moderate | Low | Very Low |
| Wells Gray North | High | Low* | Nil | Low |
| Barkerville | High | Very Low | Nil | Low-Moderate |
| North Cariboo Mountains | High | Low | Low | Low |
| Narrow Lake | Low* | Very Low | Nil | Very Low |
| George Mountain | Low-Moderate | Nil | Nil | Very Low |
| Hart Ranges | High | Low | Nil | Very Low |

Sources: B. McLellan (MOF), Trevor Kinley, Guy Woods (MELP), Mike Burwash (MELP), Jeff Morgan (MELP), Glen Watts (MELP), Jim Young (MELP) – pers. comm.

*potential for increased conflict due to new commercial enterprises or future road access

localized due to the broken terrain and lack of long gentle ridges, however, snowmobile activity is considered to pose moderate to high risks to Caribou (Table 1). Further to the south this herd occupies a U.S. wilderness park which prohibits snowmobile use. However, similar to parks in Canada, enforcement remains problematic. Because there are currently no tenured heli-ski operations, and because heli-skiing capability in the south Selkirks does not significantly overlap with Caribou areas, current and future impacts from heli-skiing is estimated to be nil to low (Table 1). Snow-cat skiing does occur in the south Selkirks, but is not extensive at this time. Although there is potential for expansion, overall, this type of alpine skiing is also estimated to pose relatively low threats to Caribou (Table 1).

South Purcells

The majority of the south Purcell Mountains receives high snowmobile activity, which poses moderately high threats to Mountain Caribou. The extensive subalpine ridges and gentle terrain found in the south Purcells provide both high capability snowmobile terrain as well as high capability Caribou habitat. This overlap has resulted in growing concerns over expanding

snowmobile activity in this area. In particular, increased road access (mineral development) into the Buhl and Skookumchuk drainages located in the Invermere Forest District (accessing from Cranbrook) are high conflict areas. Although some access restrictions are in place, enforcement remains a problem.

Due the more subdued terrain, heli- and snowcat ski operations are limited and pose relatively low concerns for Caribou in the south Purcells. Although more backcountry skiing does occur, the relative impacts from this non-motorized activity are estimated to be low (Table 1).

Central Selkirks

Similar to other areas in the North Columbia and Selkirk Mountains, snowmobiling is a growing concern for Caribou in the Central Selkirks, especially near Nakusp and Silvercap Ridge. In addition, heli-skiing as well as snowcat skiing is considered to pose moderately high risks to Caribou in the area (Table 1). Snowcat skiing is growing in the Central Selkirks, especially in the Trout Lake area. Backcountry skiing is popular, but not expected to create significant conflicts between Caribou and skiers at present or in the future.

Monashee

Snowmobiling is a moderate to high concern in the Queest and North Queest Mountain areas as well as Eagle Pass, Grace Mountain and Bischoff/Celista Mountains. In addition to snowmobiling, the Queest Mountain area receives relatively heavy backcountry ski use. Although there are no snowcat ski businesses currently operating, there is one snow-cat skiing proposal under review. Therefore, there is the potential for cumulative winter recreation impacts to Caribou in the Queest Mountain area. Overall, the snowmobile use and heli-skiing pose the greatest threat to Caribou in the Monashees whereas snow cat skiing and backcountry skiing pose relatively low risks (Table 1).

Revelstoke

Snowmobile activity is a major concern in the Revelstoke area. Identified conflict areas are located near Revelstoke and north along the east side of the reservoir. Frisby Ridge and Boulder Ridge both receive extensive snowmobile use. On the east side of the reservoir, Sale Mountain, Keystone Ridge and Cariboo Basin north of Downie Creek are also regularly used by snowmobilers. Parks Canada is also concerned about snowmobiles illegally entering Glacier National Park. Although there is a high level of concern regarding snowmobile use in Caribou winter range, cooperation from local snowmobile clubs has resulted in some access restrictions, designated trails and self-policing to minimize harassment of Caribou.

In addition to snowmobiling, heli-skiing is a relatively high concern throughout the Revelstoke District where four commercial lodges exist. Although snowcat skiing occurs, it is not extensive at this time. Backcountry skiing is popular, but is considered to pose relatively low risks to Mountain Caribou (Table 1).

Central Rockies

Due to the steep rugged terrain and glaciers present in the Central Rockies, habitat capability for Caribou is relatively low, as is the capability for most backcountry recreation activities. Although some commercial heli-skiing occurs in

the alpine areas of Howard and Foster Creek in the Robson Valley, overall, the potential for all backcountry recreation activity to pose significant threats to Caribou is low (Table 1).

Wells Gray South

The Wells Gray South subpopulation includes Caribou that reside in Wells Gray Provincial Park and in the North Thompson area. Snowmobile concerns are highest in areas outside Wells Gray Provincial Park and are concentrated in the Clearwater Forest District. The Miledge Creek drainage is of particular concern due to high Caribou use as well as Allen and Clamina Creeks and the Raft/Trophy Mountain area. Currently MELP is working with snowmobile clubs to try to reduce snowmobile-Caribou conflicts. At present there is an access restriction (snowmobile) in place for the Miledge Creek area. Although there is heli-skiing operation south of in Blue River, heli-skiing, snowcat skiing and backcountry skiing are considered to pose only moderate to low risks to Caribou in this area.

Wells Gray North

The Wells Gray North subpopulation includes animals that live predominately in the Quesnel Highland. Snowmobiling is a relatively high concern north-east of Likely and east of Horsefly including areas north of Quesnel Lake which are all occupied by Caribou. Specific areas that receive high snowmobile use include Cameron Ridge and Mica Mountain (accessed from 100 Mile) which includes Boss and Deception Mountains. Eureka Peak, which is accessed from Williams Lake, has been closed to snowmobilers; however, compliance and enforcement remain problematic. Snowmobilers also use Pegasus Creek and Billy Miner Creek. Heli-skiing is currently a relatively minor concern; however, expansion of commercial tenures in the Niagara/Mitchell River area is a potential concern (Table 1).

Barkerville

The Barkerville subpopulation (40-50 Caribou) includes Caribou that reside west of Bowron Provincial Park. Areas of concern include the western highlands accessible from Likely and

Wells, particularly Ground Hog Lake and Yanks Peak. Yanks Peak receives extensive snowmobile use but is no longer occupied by Caribou. In addition, there is one commercial tenured snowmobile trail riding business, which operates out of Wells. There are no snowcat ski operators in the area and they are not likely to develop in the future due to the relatively gentle terrain. Similarly, heli-skiing is not a major concern due to low terrain capability. Backcountry skiing is popular and considered to pose low to moderate threats to Caribou (Table 1).

Land use conflicts between backcountry recreation users and wildlife are being addressed at sub-regional planning committees.

North Cariboo Mountains

Snowmobile use is a relatively high concern for Caribou sub-populations in the North Cariboo Mountains (Table 1). In particular, Bell and Lucille Mountain in the Robson Valley receive moderately high use and are occupied by a small number of Caribou. The recent designation of Sugarbowl Mountain as a new park [Prince George Local Resource Management Plan (LRMP)] precludes snowmobile use in the Grizzly Den and Raven Lake areas, however, due to lack of enforcement, snowmobiling still occurs in the new park. Other areas that receive moderately high use include Haggan Creek east of the Bowron Valley.

Narrow Lake

Situated to the west of the Bowron Valley, the Narrow Lake Caribou population is at relatively low risk from backcountry recreation activities. Although Narrow Lake could provide snowmobile as well as backcountry ski opportunities, which could potentially affect the small number of Caribou using this ridge (~40), the area currently does not have road access. This could change, however, as surrounding areas are developed. Heli- and snowcat skiing are considered to pose very low concerns due to terrain limitations (Table 1).

George Mountain

George Mountain continues to receive moderately high levels of snowmobile activity due to its proximity to Prince George, accessibility and gentle terrain. There is also an extensive trail system in the area that connects to the Barkerville area (Beardmore and Kaegi 1999). Although the George Mountain herd has continued to decline to relatively few animals (< 50), the cause(s) of the decline remain unclear. The isolated nature and future viability of this small population resulted in it being ranked last priority for conservation effort (Simpson et al. 1997). Nonetheless, there remains a moderate level of concern for this population, especially if the relatively high snowmobile use contributed to decreased use of the area (Table 1). The gentle terrain of George Mountain significantly reduces the capability for heli- and snowcat skiing and therefore, is not a concern for these animals. Backcountry skiing occurs, but only to a minor extent.

Hart Ranges

Areas that currently receive extensive snowmobile use and are also occupied by Mountain Caribou include Torpy Ridge in the McGregor Mountains, Captain Otter near Arctic Lakes as well as portions of the Dezaiko Range near Hedrick Lake and Gleason Creek. Further to the east in the Robson Valley Forest District, Mt Renshaw and Dore Creek also receive extensive use by snowmobiles. Overall, the extensive subalpine terrain in the Hart Ranges provides high snowmobile capability, which results in relatively high impact on Caribou in these areas. In contrast, other backcountry recreation activities are considered to pose considerably less risk to Caribou (Table 1).

INTERIM MANAGEMENT GUIDELINES

To address the potential negative effects of backcountry recreation activities on mountain Caribou, the following section briefly outlines interim management guidelines that are either in place or could be considered as options to reduce potential impacts. Because there is a clear need to conduct research studies that examine how Caribou are affected by backcountry recreation activities and to evaluate the effectiveness of management guidelines, these measures should

be viewed as 'working hypotheses'. Moreover, because there is inherent uncertainty regarding the specific responses of individual Caribou and even more uncertainty regarding population or demographic consequences these interim measures reflect the *precautionary principle*¹. Some of these management guidelines have been taken from the Draft Recreation and Wildlife Policy report currently being prepared by the Wildlife Branch.

In areas where there is both high capability snowmobile terrain and/or heli-skiing as well as high capability Caribou winter range, the following recommendations are suggested:

- Preclude snowmobile use within high sensitivity areas. These areas typically include late-winter subalpine parkland foraging areas but may also include mid- and low-elevation early-winter habitats.
- Regulate snowmobile activity through zoning and timing restrictions in areas with existing snowmobile use that are occupied by Caribou.
- Prohibit trail expansion into new areas occupied by Caribou.
- Focus trail expansion and encourage use in areas that already receive extensive snowmobile use and where Caribou are rarely present (e.g., Yanks Peak, George Mountain, Boulder Ridge).
- Consider designating new trails in areas which snowmobilers wish to access but are used less by Caribou (e.g., glaciers). Ideally these would occur in areas that do not conflict with heli- or backcountry ski touring.
- Promote responsible snowmobile club policies such as off-trail restrictions, code of conduct and self-policing, similar to management guidelines developed for the Revelstoke area.
- Limit helicopter flight altitudes to above 300 m in areas of high capability Caribou habitats.
- Avoid known high suitability winter range areas with designated (approved) flight paths.

¹ The *precautionary principle* is typically invoked by resource managers to ensure that a lack of full scientific certainty is not used as a reason for postponing measures that could be implemented to reduce impacts to wildlife populations. To address uncertainty, *adaptive management* should be used to develop scientifically supportable management guidelines.

- Examine the feasibility and cost-effectiveness of using Conservation Officers/Park Wardens to conduct periodic monitoring of high use snowmobile areas.
- Develop an education program (extension materials) designed to inform the public about Caribou and risks of disturbance.

RESEARCH NEEDS

The main objectives must be to clearly document the impacts of backcountry recreation activities on Mountain Caribou. Recreational clubs and commercial tourism operators have a strong voice in local communities and they resist attempts to control their activities on public lands. Their contribution is significant in supporting the hospitality industry and many other service providers in small communities. The political force of these organizations, which may oppose management constraints, must be countered with well-documented information that clearly demonstrates the level of environmental risk associated with each backcountry recreation activity. Wildlife population status does not generate the same level of concern to residents as does the potential loss of the economic and social benefits generated by winter recreation activities.

It is clear from the preceding discussion that Caribou will tolerate some mechanized winter recreation activities within their range. The challenge for wildlife managers is to define acceptable levels of activity and thresholds beyond which unacceptable negative impacts can be expected.

The first difficulty for Caribou is defining what is an "unacceptable negative impact". Few would argue that a herd of Caribou run to exhaustion by a helicopter would be considered unacceptable. Less dramatic effects on Caribou, such as running a short distance, changes in movement patterns, or longer movements to undisturbed areas may be considered acceptable by many. The first challenge is to convince the public that less dramatic effects are cause for serious concern. Unacceptable negative impacts can then be defined and agreed to by all concerned parties.

Documentation of population or productivity declines would be useful, however, establishing

the cause(s) are obviously problematic. The focus of this research must be on factors that can be clearly related to backcountry recreation and disturbance.

Some suggested indicators that could be used to identify unacceptable impacts in areas used for winter recreation may include:

- long term absence of Caribou from suitable winter range;
- movement of Caribou from disturbed to undisturbed habitat areas particularly if intervening terrain is unstable and prone to avalanching;
- excessive running/bounding of Caribou on winter ranges (as evidenced by tracks/gait)
- predators present on winter ranges;
- lower than expected use of good quality ranges/habitats by Caribou;
- higher than expected use of poor quality ranges/habitats by Caribou.

Each of these impacts assumes that we can establish "normal levels" from undisturbed ranges. Although some Caribou have been shown to have strong fidelity to winter ranges, other herds are notoriously unpredictable in their range use strategy and can show little fidelity to particular wintering areas (Terry 1993). Since change can be a normal part of their home range patterns, it may be difficult to argue that absence or range use changes are an "unacceptable impact" to Caribou. Fortunately, there are a number of long term Caribou telemetry data sets from the North Thompson, Revelstoke, South Selkirks, Quesnel Highland, Wells Gray and Cariboo Mountains which could be re-analyzed to establish the "norms" (Simpson and Woods 1985; Antifeau 1987; Seip 1990, 1992; McLellan and Flaa 1993; Terry 1994). Information from some of these previous Caribou studies could be re-analyzed to establish the level of impact from winter recreation and demonstrate "unacceptable impacts" on Caribou populations. This will be a pre-requisite to obtain public support, particularly for the proposed adaptive management programs, which will significantly affect current backcountry user groups.

Through the 1980s, fewer areas were subject to disturbance than are at present. Much of the

information from that period could be used to establish benchmarks against which current information can be assessed. For example, Caribou Ridge north of Revelstoke was not used by Caribou during the first two years of the 1981-86 telemetry study, and there was no human disturbance in the area during that entire time. Caribou Ridge was regularly occupied in the final four years of the study. The "normal" patterns of range use in the absence of disturbance must be documented if we hope to establish any cause/effect relationships in disturbed areas.

Some critical data that should be obtained to address potential impacts and working hypotheses include:

- The historical frequency that suitable ranges were occupied (or not) for all or part of a winter
- The historical frequency that Caribou moved from one ridge to another through difficult terrain
- The pattern of movement on wintering areas, i.e., unidirectional or wandering

It is unlikely that the frequency that Caribou were observed running or that evidence of predators found on winter ranges would have been consistently recorded in older studies. Such data can be collected from current studies if the level of disturbance and type of disturbance in each area occupied by Caribou can be quantified. Standard use/availability statistics can be applied, comparing habitat use patterns in disturbed to undisturbed study areas. Much of that data is being collected in any case, so what is required is accurate quantification of the disturbance type and intensity level.

The authors believe that the analyses and new data gathering suggested above would provide the strongest evidence of "unacceptable impacts". Existing studies could provide most of the new data required with some additions to their data collection procedures. Proper presentation of the results will provide the best opportunity to attain public support for some restrictive management programs, which will very likely be required to maintain Caribou populations.

Key questions which must be addressed include:

1. What level of backcountry use resulted in range abandonment?
2. What level of backcountry use resulted in Caribou switching ridges?
3. What level of backcountry use resulted in directional movement from high disturbance to low disturbance areas?
4. How often do Caribou run in disturbed and undisturbed habitats? (Is there a relationship between the frequency of running and the disturbance level?)
5. Are predators more often present on disturbed ranges than on undisturbed ranges? (Do predators use packed trails to access the Caribou winter ranges?)

It should be noted that each of the questions above requires estimation of numbers and types of users. The best source of this information will be the user groups themselves. Co-operation in obtaining accurate data may be problematic if users are aware of the purposes of the study.

A second approach could involve experimental or controlled disturbance to Caribou with the objective of documenting tolerable types and levels of disturbance. Direct observation can be used to document overt responses to disturbance, such as changes in behaviour (bedded to standing), walking away or running. Information recorded should include the speed and closeness of the approach and the duration of the response. For snowmobiles, the number of riders and spacing and speed should all be controlled/recorded. Experimental approaches should be designed to test responses to visual, sound, motion and scent stimuli. The results of this work may be most useful for setting codes of behaviour in many areas where disturbance cannot be eliminated through total closure.

In addition to the two approaches outlined above, other related questions may be answered using adaptive management and monitoring approaches. These may include:

1. If backcountry recreation activity is prohibited in areas formerly occupied by Caribou, will they resume use? If so, how many years does it take?
2. If total human use is controlled but not eliminated, will Caribou remain in suitable habitat

areas through the winter? (i.e., Caribou do not move to an undisturbed part of their range.)

3. Will "educated users" follow regulations such as staying on trails in open subalpine Caribou habitats?
4. If educated backcountry users demonstrate appropriate behaviour, do Caribou tolerate their presence? (i.e., will Caribou demonstrate similar behaviours and movements as on undisturbed ranges.)

Although other study areas exist where the questions outlined above can be addressed (e.g., Cariboo Mountains), Revelstoke in particular presents a good opportunity for future adaptive management and experimental studies because:

1. all types of backcountry recreation occur in the area and Caribou numbers are sufficient to enable data gathering on their behaviour.
2. varying levels of recreational use occur throughout the Caribou range, and the west side of the reservoir is still largely undisturbed by ground-based users.
3. some areas closed to snowmobiling exist.
4. some areas with a long history of heavy snowmobile use exist.
5. the education and self-regulating program has been in place for several years, and should be evaluated.
6. work is ongoing on Caribou and funding is available.

Recommended Research Program Steps

The following steps outline the suggested approach which could be used to successfully implement the "backcountry winter recreation impact on Caribou" research program:

1. Distribute this discussion document to researchers in B.C. and the USA for comments and suggestions.
2. Obtain access to and agreement for use of old Caribou research data.
3. Quantify historic levels of recreation use through expert opinion (old data) recreation club records, and Lands Branch records (special use permits).
4. Prepare a report documenting the "unacceptable impacts" of past recreation activities on Caribou and define impact indicators (absence from

suitable ranges, unusual movement patterns, evidence of running, presence of predators).

5. Distribute report and conduct public information meetings to garner support for more restrictive management of winter recreation.
6. Implement experimental/controlled disturbance trials to document Caribou overt responses (short term).
7. Implement adaptive management trials by altering recreational use and monitoring Caribou responses (long term).
8. Define additional data to be collected by existing Caribou research projects and the funding augmentation required.

One individual or a central group should be responsible for co-ordinating the various activities and the researchers. Co-operation of the researchers will be essential to the overall success of the project given the modest level of funding currently available.

The political/administrative challenges can only be handled by appropriate government staff, with legislative authority for management and protection of wildlife. It is currently considered unlikely that restrictive management programs may be implemented without strong public support. Regional and Provincial agency staff may be required to conduct public information meetings in communities affected by changes to existing management of winter recreation activities. Funding will likely be required to cover travel and facilities for this activity.

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